

Ecological Risk Assessment

HOW THE AMERICAN ROBIN CAN CONTROL YOUR
REMEDIATION LEVEL



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Presentation Overview

What is an Ecological Risk Assessment?

Common Concepts

Conducting an ERA – the Tiered Approach

- Tier 1
- Tier 2
- Tier 3

What's New? – Recent Guidance

What is an ERA?

...a process that evaluates the **likelihood** that **adverse ecological effects** are occurring or may occur as a result of exposure to one or more **stressors** (EPA, 1992).

...a document that provides a risk management recommendation.



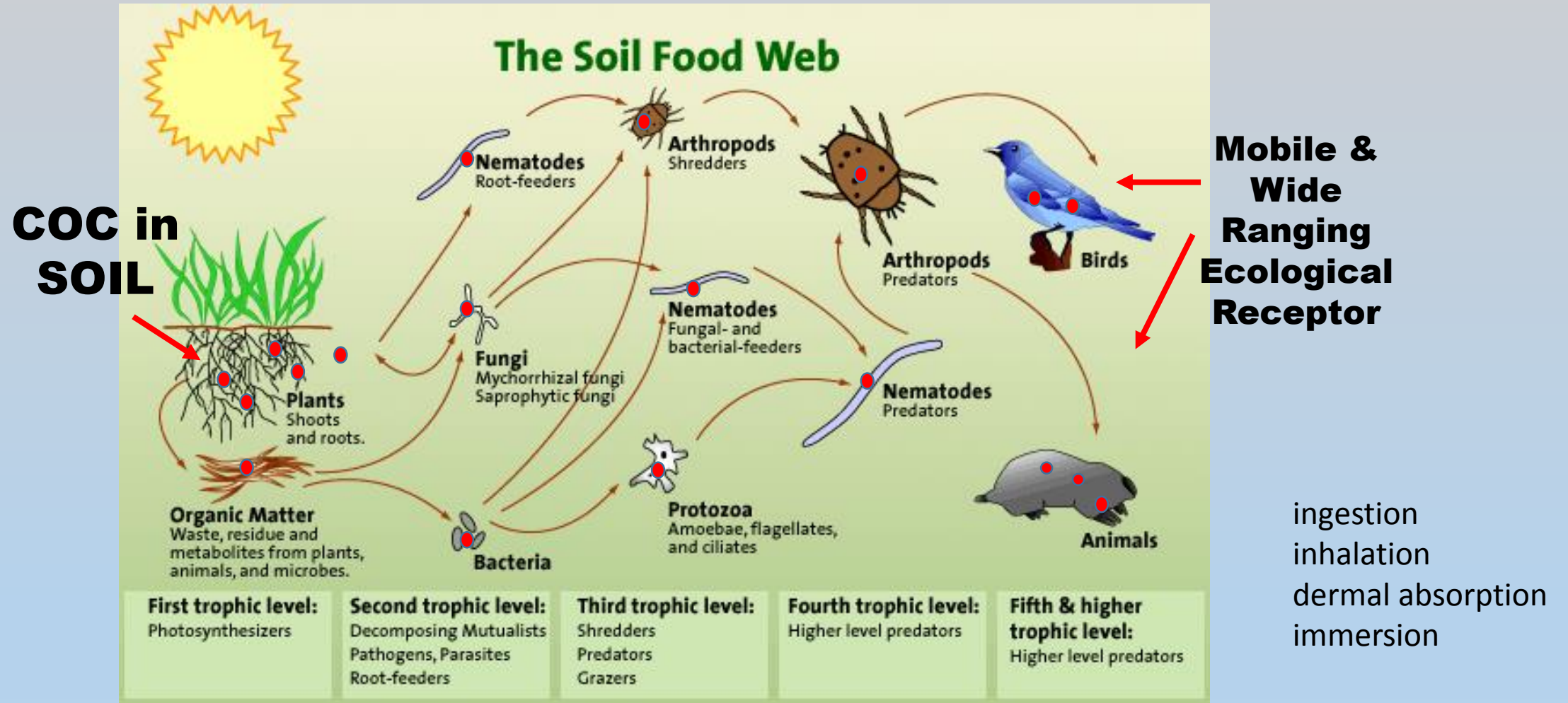
Common Concepts

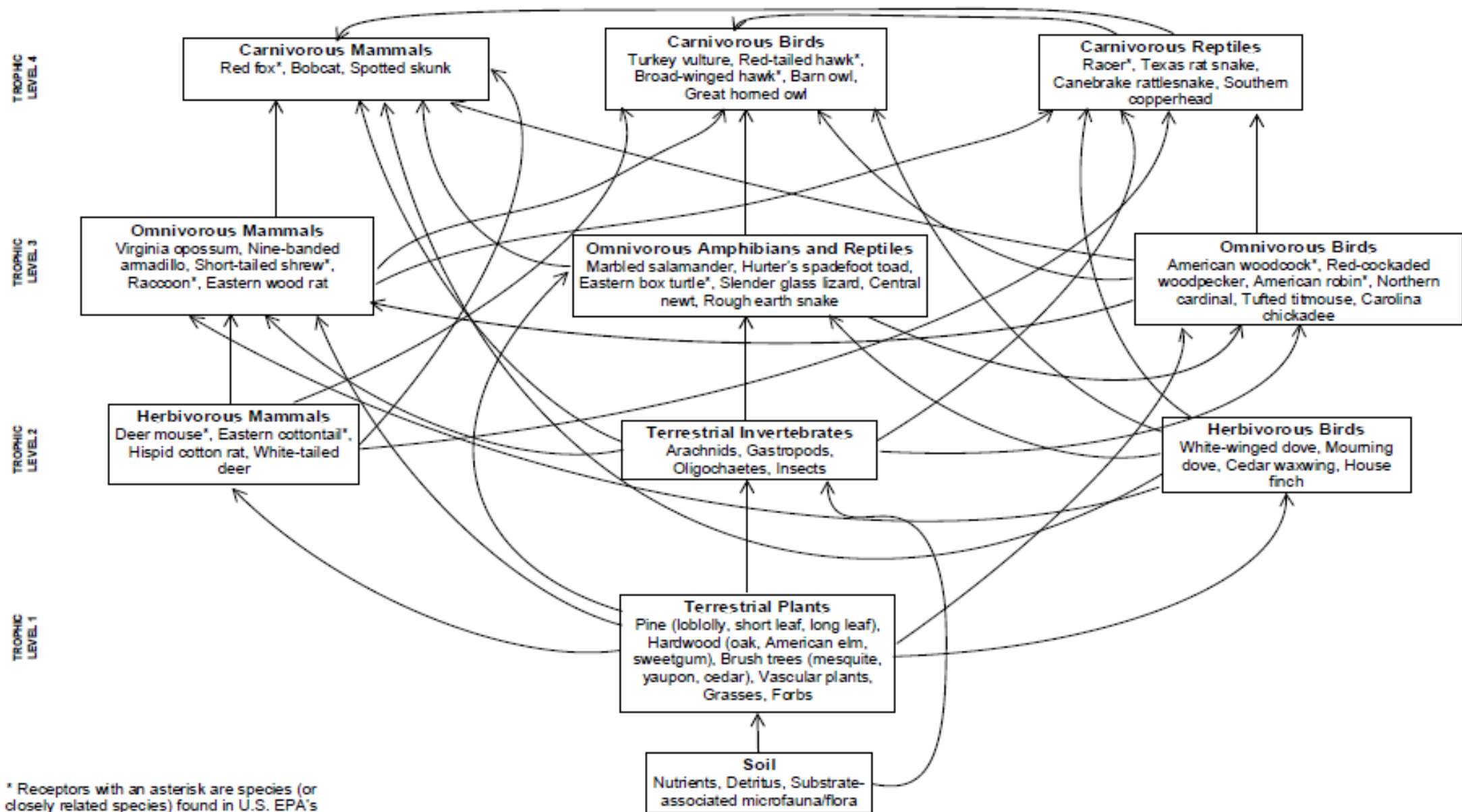
EXPOSURE MEDIA

- Surface Water
- Sediment
- Surface Soil
(0 to 0.5 ft bgs)
- Subsurface Soil
(0.5 to 5 ft bgs)



Complete Exposure Pathway

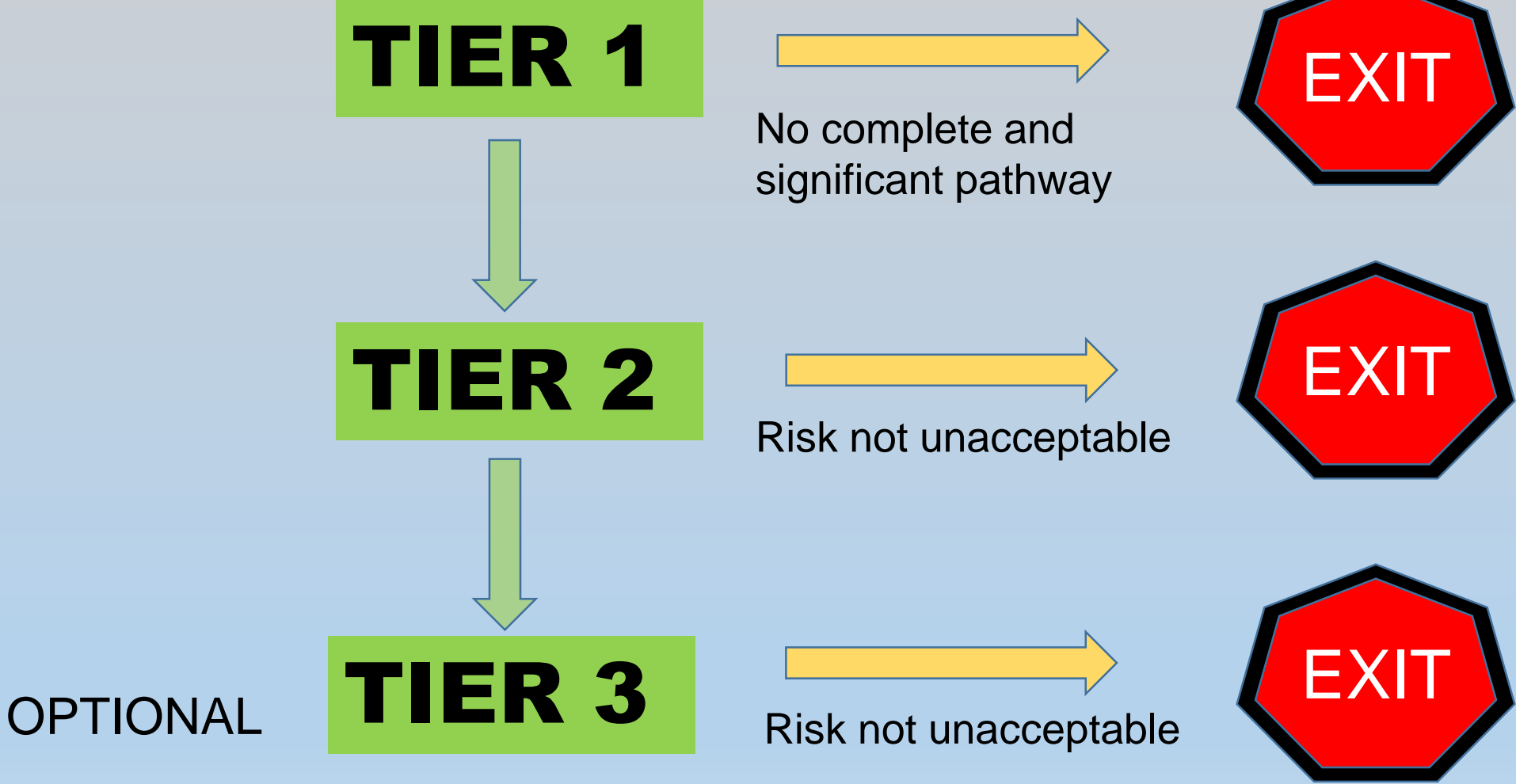




* Receptors with an asterisk are species (or closely related species) found in U.S. EPA's *Wildlife Exposure Factors Handbook* (1993a)

Figure A.2. Tallgrass-prairie food web.

The Tiered Approach



Tier 1 – Exclusion Criteria Checklist

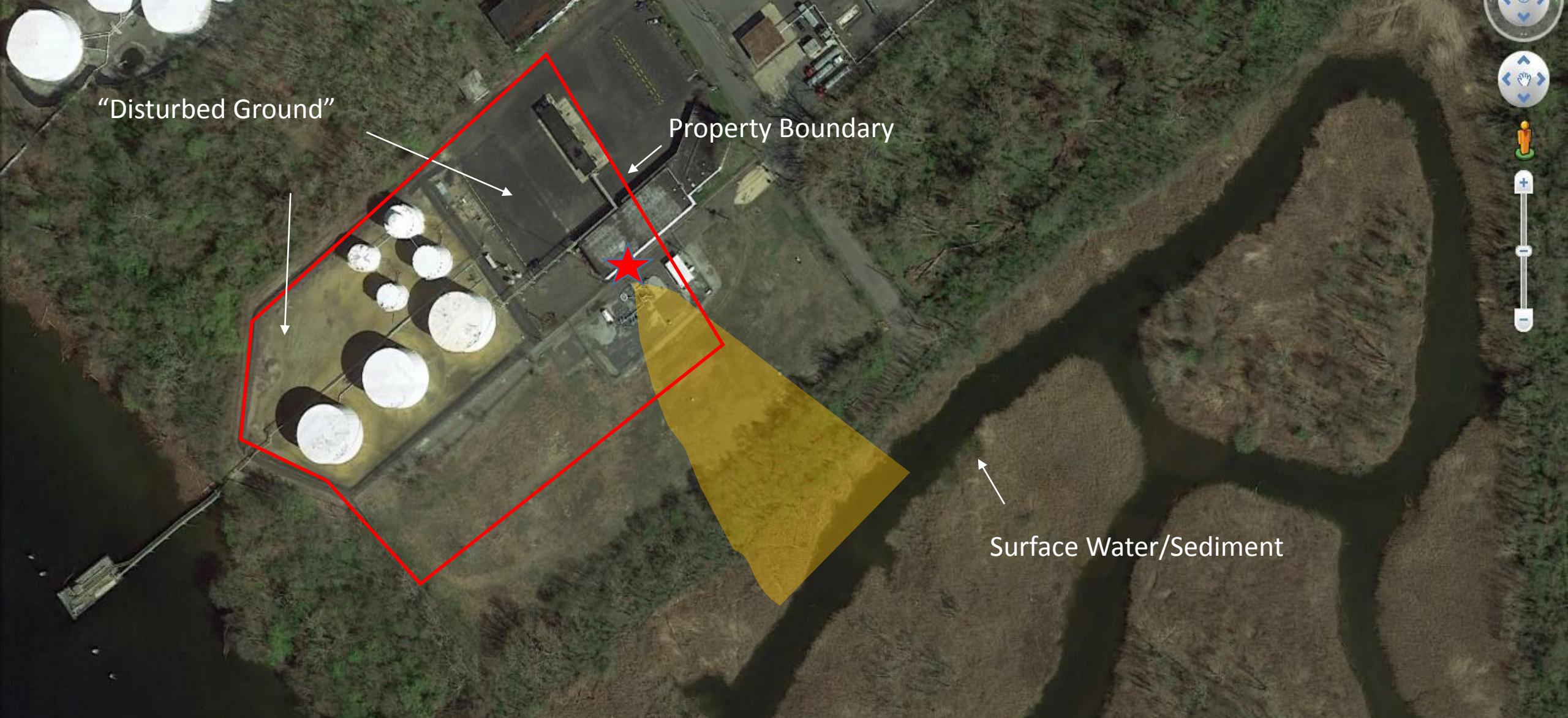
- No complete pathway to nearest waterbody (eliminates surface water);
- No COCs within top 5 feet of ground surface (eliminates soil); or
- Affected area is “disturbed ground”; or
- De Minimis* Land Area
 - ✓ Affected area is now and will remain \leq 1 acre; and
 - ✓ No impact on Protected Species; and
 - ✓ Similar habitat within 0.5 mile; and
 - ✓ Not within 0.25 mile of sensitive area.

Two Texas Wildcards – More Tier 1 Exit Strategies

- Reasoned Justification
- Expedited Stream Evaluation



Expedited Stream Evaluation – Pathway not substantial



"Disturbed Ground"

Property Boundary

Surface Water/Sediment

Tier 1 Example – Soil eliminated due to incomplete exposure pathway (disturbed ground)but Groundwater to surface water / sediment pathway is complete

Tier 2 – Screening Level ERA

1. Screen COCs against ecological benchmarks.
 - retain COCs/media that exceed benchmarks/background.
 - retain COCs that are bioaccumulative.
2. Select receptor species (guilds) and describe food webs.
3. Dose the eco-receptors and evaluate the risk.
4. If required, calculate concentration that would produce acceptable risk (i.e. the Eco-PCL).



First Step in Tier 2 - Screen COCs against Ecological Benchmarks (e.g. Soil benchmarks)

“safe” levels

Surface Soil Chemical of Concern	Maximum Site Surface Soil Concentration (mg/kg)	Maximum Site SUB-surface Soil Concentration (mg/kg)	Soil Ecological Benchmark (mg/kg)
Benzene	0.250	0.05	0.255 ^a
Ethylbenzene	20	0.03	0.05 ^a
Toluene	19	10	200 ^b
Xylenes	0.012	0.04	0.05 ^a
Total PAHs	0.08	0.06	2.8 ^c

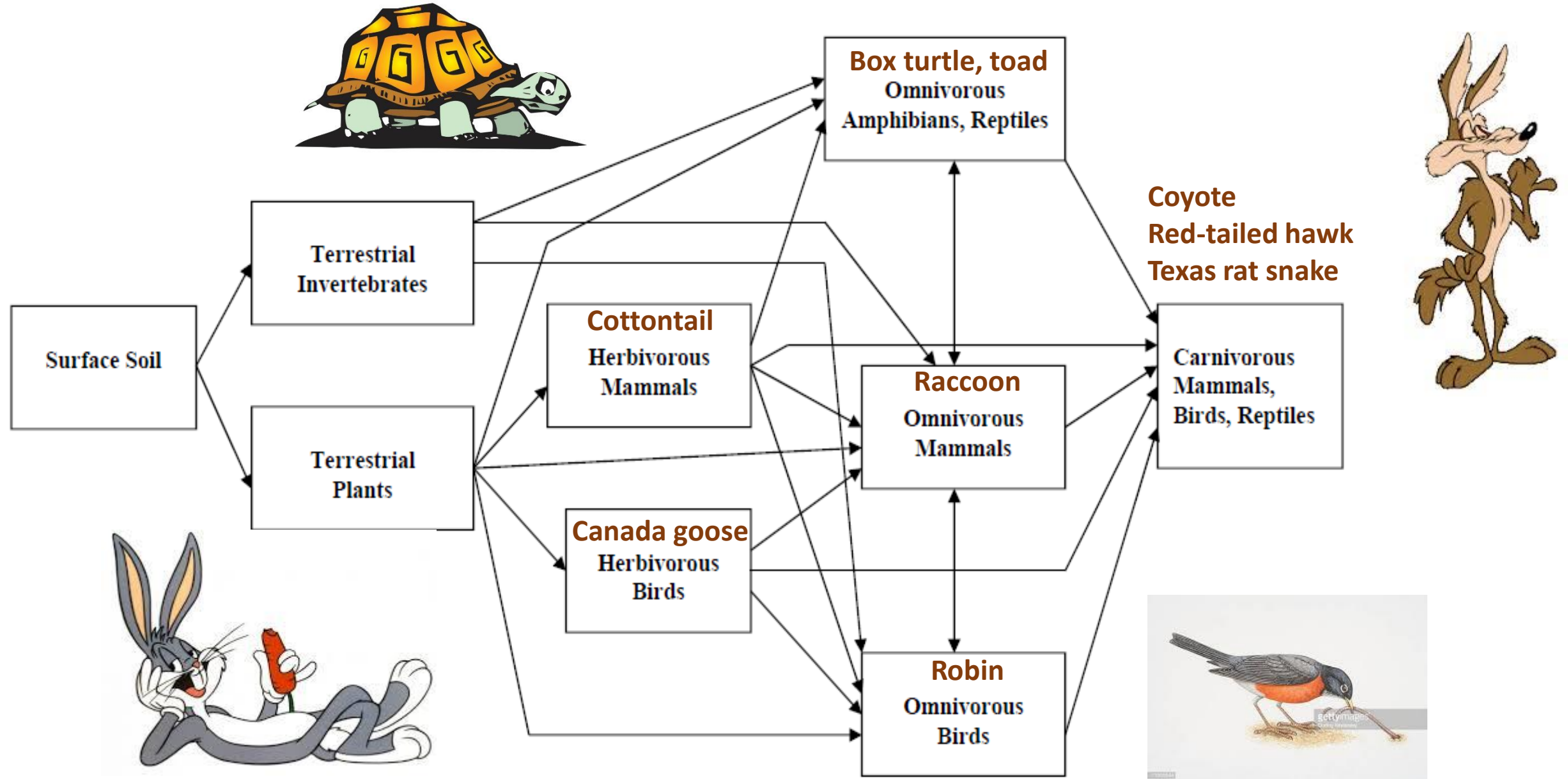
^a Benchmark from EPA Region 4 (2001).

^b Benchmark from TCEQ.

^c New benchmarks from TCEQ

Only ethylbenzene in surface soil is carried forward.

Tier 2 Step 2 – Surface Soil Ecological Receptors & Pathways



Initial Exposure Example – Robin & Ethylbenzene

Robin food
ingestion rate
(kg/d)

Robin water
ingestion rate
(L/d)

Ethylbenzene concentration
in water (mg/L) = $95\%UCL_{wtr}$

Robin incidental
soil ingestion
rate (kg/d)



Ethylbenzene concentration
in food/soil (mg/L) = $95\%UCL_{soil}$

Robin body weight (kg)

$$\text{Ethylbenzene Dose} = \frac{[EB_{food} + EB_{soil} + EB_{water}]}{BW} = \text{mg/kg-d}$$

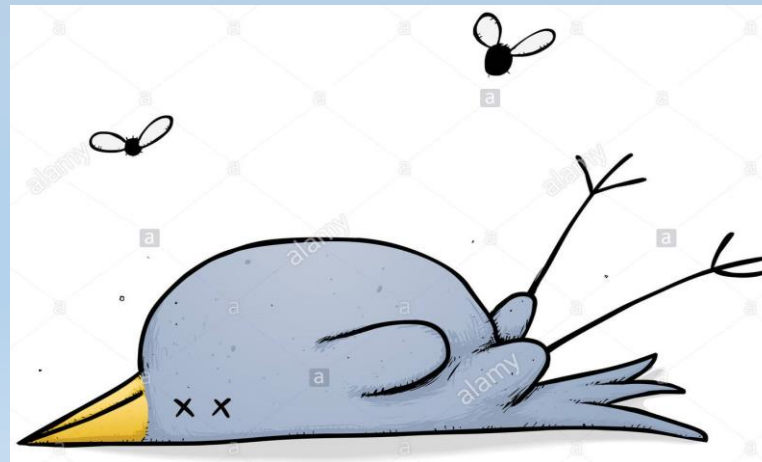
Calculate the Worst Case Daily Dose –

Initial Assessment Exposure Dosage Calculations for Ethylbenzene in Surface Soil.



Soil Representative Species	Body Weight (kg) ^a	Food Ingestion Rate (kg/day)	Soi Conc. (mg/kg)	Media Conc. (mg/kg)	Food Conc. (mg/kg)	Soil Ingestion ^c (% of Food Ingestion)	Water Ingestion Rate (L/day)	Surface Water Conc. (mg/L)	Dosage Oral (mg/kg /day)
Robin	0.345	0.2428	19	19	19	2.4	0.1184	0.02	44

Robin Toxicity Reference Value (TRV) = 33 mg/kg-day



Modify the Assumption that Robin Feeds Exclusively within Affected Area

Affected Area = 0.6 ac

Home Range = 0.53 ac



$$\text{Area Use Factor (AUF)} = \frac{\text{Affected Area}}{\text{Home Range}} = 1.0$$

In our example, all the species drop out except the Robin.....

The Conclusion of Tier 2

1. Any PCLs provide the basis the conclusion of the ERA.
2. Risk Management Recommendations conclude the ERA
 - a. *Remove the media containing the COC to the PCL level.*
 - b. *Decontaminate the media to the PCL level.*
 - c. *Controls that will eliminate exposure (capping, etc.).*
 - d. *Ecological Services Analysis – considers losses associated with the remedy
- requires approval of “Trustees”.*

Tier 3 – Site-specific ERA

- Some Tier 3 actions could include:
 - tissue residue and bioaccumulation studies
 - comparison of site data to reference area data (e.g. surveys)
 - toxicity tests with site-collected media
- Optional, time-consuming, costly

New Developments

1. The Ecological PCL Database ...
provides default PCLs for soil and sediment for various wildlife species
2. PCBs – analyze for congeners of PCBs instead of Aroclors (toxicity is congener-specific).
3. Case Study – RG-263c online ...
illustrates new concepts such as PCL database and ESA
4. PAHs – evaluate as TOTAL PAHs...
only use individual PAH if no benchmark available for total
5. Livestock exposure – guidance and safe levels

QUESTIONS??

Tier 2 Step 3 – Exposure Assessment

- Calculate the 95%UCL of the COC concentrations in each retained media (e.g. 190 mg/kg Naphthalene)
- Develop an “exposure model” for representative species.
- Calculate the initial (worst case) exposure as a daily dose via oral ingestion.
- Compare that daily dose to a threshold “no effects” dose

Protective Concentration Level (PCL_{eco})

The ecological PCL is a concentration of a COC within an exposure medium (e.g. soil, sediment, surface water, groundwater) that is protective of:

- (1) wider-ranging ecological receptors that may frequent the affected property and use less mobile receptors (e.g. plants, soil invertebrates, small rodents) as a food source, and
- (2) benthic invertebrates within surface waters in the state

Note that PCLs are not intended to protect receptors with limited mobility or range (e.g. plants and soil invertebrates)

TIER 1 – Exclusion Criteria Checklist

